International journal of
adulteration

Risk of adulteration in milk consumed at Shaheed Benazirabad District of Sindh

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To Cite:
Barham GS, Khaskheli M, Soomro AH, Nizamani ZA. Risk of adulteration in milk consumed at Shaheed Benazirabad District of Sindh. *International journal of adulteration*, 2017; 1: e3ijad3005

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Peer-Review History
Received: 19 February 2015
Reviewed & Revised: 27/August/2015 to 12/October/2017
Accepted: 23 October 2017
Published: 27 October 2017

Peer-Review Model
External peer-review was done through double-blind method.

International journal of adulteration
eISSN (Online) 2456 – 0294

ABSTRACT

In the current scenario, food adulteration is major issue of significant importance in the developing world. Specially milk adulteration paid more attention in this regard and this unethical activity is practiced frequent. Milk marketing channels are directly involved in this unethical activity. The study was planned to detect different adulterants in the market milk sold in the locality of Shaheed Benazirabad formerly Nawabshah district of Sindh during the year 2014. A total of 100 milk samples were collected, twenty (n= 20) from each milk producers (MP), milk collectors (MC), middlemen (MM), processors (P) and dairy shops (DS), were observed for different adulterants. Among these adulterants water was found in bulk of milk samples, followed by detergent, starch, rice flour, cane sugar, skimmed milk powder, caustic soda, formalin, vegetable oil, hydrogen peroxide, sodium chloride, urea, ammonium sulfate, boric acid, glucose, arrowroot, and sorbitol. Freezing point of 50% milk samples of MP, 70% of MC, 75% of P, 80% of MM, and 95% of DS appeared towards 0 ^{o}C rather than that of control milk, and assumed to be adulterated with extraneous water. The extent of extraneous water in milk sold at DS, MC, P and MM was non-significant ($P>0.05$) with each other, but remarkably higher ($P<0.05$) as compared to MP. The ratio of adulteration among DS, MM and MC was found non-significant ($P>0.05$) with each other, but significantly ($P<0.05$) higher than P and MP.

Key words: Adulteration, extent of extraneous water, freezing point and market milk.

Abbreviation: AS - Amonium sulfate, AR - Arrowroot, B.Acid - Boric acid, C.Sugar - Cane sugar, C.Soda - Caustic soda, DS - Dairy shops, H2O2 - Hydrogen peroxide, MC - Milk collectors, MM - Middlemen, MP - Milk producers, NaCl - Sodium chloride, P - Processors, SMP - Skimmed milk powder, RF - Rice flour, V.Oil - Vegetable oil.

INTRODUCTION

Food should be without or only with acceptable and safe levels of adulterants, contaminants or any other substances that may make food hazardous to

health. Also, such food can deprive nutrients essential for proper body growth and development (Neumann et al. 2002). Therefore, health hazards related to foods and food products are considered to be a major problem particularly in developing and less-developed countries. Regardless, Pakistan is the fourth largest milk producing country in the world after the united state, Russia, and India. Inspite having good position in milk producing countries the milk marketing system is under developed and traditional, the major quantity of milk is sold as raw through informal channels (GOP, 2014; Lateef et al. 2009). Unfortunately, due to unorganized and non-regulated marketing systems, the quality of milk is hardly maintained at consumer level (Javaid et al. 2009). It has been observed that adulteration of milk is one of the most serious issues that the dairy sector of Pakistan is today facing, causing not only major economic losses for the processing industry, but also a major health risk for the consumers. Due to the spread of small holding farmers and consequent supply chain complexities, milk handling processes in the traditional system are extremely unhygienic and there is no enforcement of standards, so the result is poor quality products. In order to keep milk temporarily fresh, middlemen commonly add ice to the milk, which results in dilution of milk solids. Compounding the problem, middlemen attempt to counter the dilution by adding vegetable oil, starch, flour, sugarcane, whey powder, skim milk powder, and other ingredients to extend the solid content of the milk (Fakhar et al. 2006). Besides, some adulterants like detergent are used to enhance the cosmetic nature of milk. When water is added in milk, its foamy appearance diminishes, so to give milk a foamy appearance artificially detergents are added in it. Hair removing powders (calcium thioglycolate/potassium thioglycolate/calcium salts of thiogycolic acid) and urea are added for whitening of milk and giving it genuine look. Only few grams of urea are enough to bring milk in its original state (Walker et al. 2004). However, the adulteration of milk may pose adverse effects on physico-chemical and nutritious status of milk, and may cause large problems for human health. As milk is directly related with the health of consumer and its adulteration may leads to serious health hazards, for this motive present study is planned to detect the different adulterants and level of additional water in market milk used for consumption at Shaheed Benazirabad district.

MATERIAL AND METHODS

2.1. Milk sample collection

Study was planned during the year 2013-2014 for the detection of various adulterants in the market milk consumed at the vicinity of Shaheed Benazirabad district of Sindh. A total of 100 unprocessed market milk samples each of twenty (20) from milk producers (MP), milk collectors (MC), middlemen (MM), processors (P) and Dairy shops (DS). All the milk samples were collected in sterilized screw capped glass bottles, labeled, kept in icebox and directly brought to the Dairy analytical laboratory of the Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary sciences, Sindh Agriculture University Tandojam, and stored at 4-8°C till analysis.

2.2. Detection of various adulterants

All the market milk samples were evaluated for various adulterants through commercially available milk adulteration testing (MAT) kit and techniques as reported by Tipu (2012) and Khaskheli (2010).

2.3. Presence and extent of extraneous water

Presence of extraneous water in milk samples was detected by depression of freezing point (through Cryoscope) and calculated by using following formula (AOAC, 2000).

$$\% \text{ water added} = \frac{\text{Freezing point base} - \text{observed freezing point}}{\text{Freezing point base}} \times 100$$

2.4. Statistical analysis

The data so obtained was tabulated and subjected for summary statistics, analysis of variance (ANOVA) significant differences of the means further computed using least significant difference (LSD) through computerized statistical package i.e. Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical Software, USA).

RESULTS

3.1 Detection of adulterant in market milk

Monitoring of adulteration was made at the surrounding area of Shaheed Benazirabad district, where a total of 100 milk samples were erratically collected from different marketing channels for the present study. A huge number of milk samples was adulterated with water (74%), followed by detergent (18%), starch (16%), 12% each of rice flour, cane sugar and skimmed milk powder, 11% caustic soda and formalin, vegetable oil (10%), hydrogen peroxide (9%), sodium chloride; NaCl (8%), urea (7%), ammonium sulfate (6%), boric acid (5%), glucose (4%), arrowroot (2%) and sorbitol (1%), respectively. There is no any single milk sample was found to be adulterated with salicylic acid and hypochlorite (Fig.1).

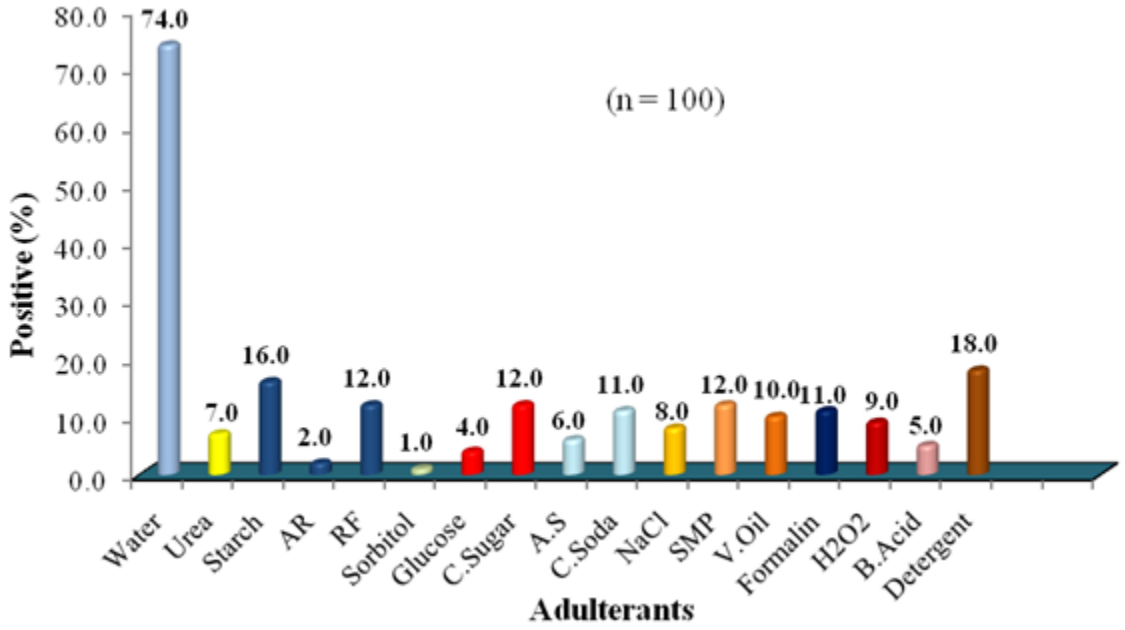

Figure 1

Adulterants (%) detected in market milk samples at Shaheed Benazirabad district of Sindh

Legends: AR = Arrowroot, RF = Rice flour, AS = Amonium sulfate, C.Sugar = Cane sugar, C.Soda = Caustic soda, NaCl = Sodium chloride, SMP = Skimmed milk powder, V.Oil = Vegetable oil, H2O2 = Hydrogen peroxide, B.Acid = Boric acid

3.2. Freezing point

Results in Table-1 showed that the average freezing point of control milk (-0.540±0.003^{0}C) varied considerably ($P<0.05$) from the milk MP (-0.467±0.227^{0}C), P (-0.410±0.025^{0}C), MC (-0.409±0.025^{0}C), MM (-0.382±0.024^{0}C) and DS (-0.336±0.021^{0}C), respectively. However, no significant difference ($P>0.05$) was observed in average freezing point of milk samples collected from MP, MC and P. Similarly, the freezing point of milk samples collected from MM and DS was found non significant. However, the freezing point of milk samples collected from MP, MC, P and DS was statistically different ($P<0.05$) from each other. Moreover, the results presented in Fig.2 showed that 95% milk samples of DS, 80% of MM, 75% of P, 70% of MC and 50% of milk samples collected from MP was in dissimilarity with the normal range of freezing point of milk (-0.522 to -0.561^{0}C) and assumed to be positive, adulterated with extraneous water, while 50, 30, 25, 20 and 5% samples were in the range of normal freezing point.

Table 1

Freezing point of samples collected from different milk marketing channels at Shaheed Benazirabad district of Sindh

Descriptive measures	Freezing point of milk (°C)						Significance	
	Control	Milk Producers	Milk Collectors	Middle men	Processors	Dairy Shops	P-value	LSD (0.05) ±SE
Minimum	-0.561	-0.571	-0.541	-0.523	-0.543	-0.524	<0.001	0.0608 ± 0.0307
Maximum	-0.522	-0.213	-0.187	-0.171	-0.185	-0.176		
Mean*	-0.540^{d}	-0.467^{c}	-0.409^{bc}	-0.382^{ab}	-0.410^{bc}	-0.336^{a}		
SE±	0.002	0.227	0.025	0.024	0.025	0.021		

*Means with different letters in same row varied significantly from one another.

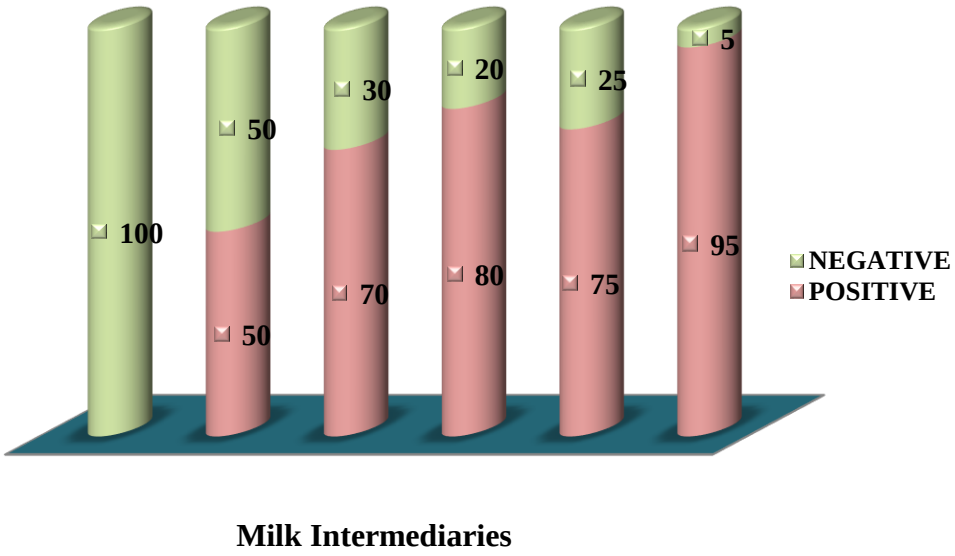

Figure 2

Market samples (%) differ from the normal range of freezing point of milk collected from milk distributers at Shaheed Benazirabad District

Legends: C = Control, MP = Milk producers, MC = Milk collectors, MM = Middlemen, P = Processors and DS = Dairy shops.

3.3. Extent of extraneous water

Extent of extraneous water of milk sold by different milk marketing channels was detected from the depression of freezing point. Results in Fig.3 showed that the water percent in milk samples collected from DS was noted as 28.50±2.13%, followed by MC (26.25±2.62%) P (23.30±3.41%) MM (22.60±2.21%) and MP (15.42±1.95%), respectively. The mean extent of water in milk sold by DS remarkably was higher than that of all other milk marketing channels, but statistically non significant (P>0.05) with MC, MM, and P except MP. However, the extent of extraneous water was found to be comparatively lower (P<0.05) in milk samples collected from MP than the other milk marketing channels.

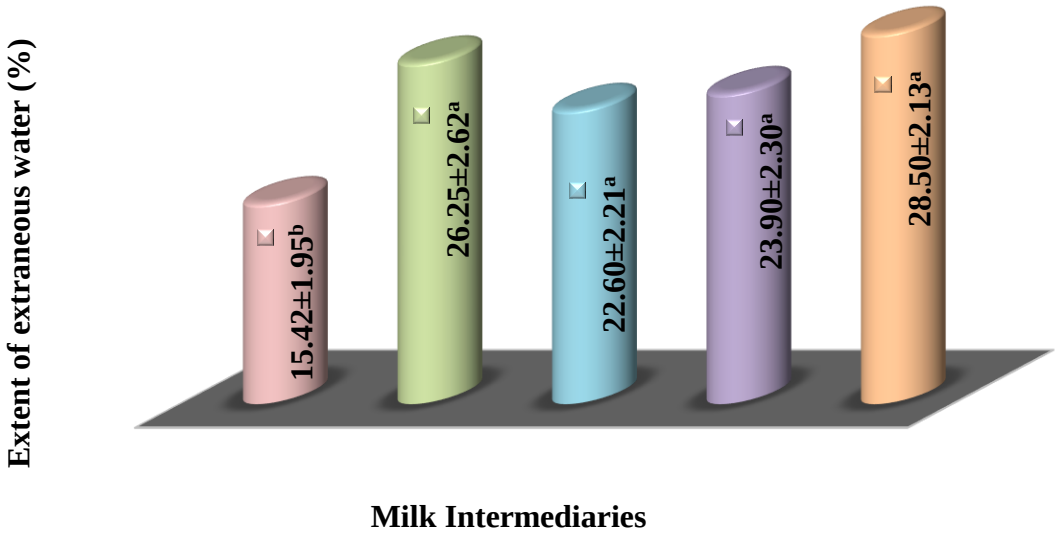

Figure 3

Extraneous water (%) in milk samples collected from different milk marketing channels at Shaheed Benazirabad District

Legends: MP = Milk producers, MC = Milk collectors, MM = Middlemen, P = Processors, DS = Dairy shops.

LSD (0.05) = 6.266

SE± = 3.184

3.4. Level of adulteration (%)

The level of adulteration in milk samples collected from DS was recorded as 3.89%, followed by MM (2.74%), MC (2.63%), P (1.63%) and MP (0.53%). Statistical analysis (ANOVA) showed that the level of adulteration was comparatively higher in samples collected from DS, but statistically non-significant ($P>0.05$) with MM and MC. Adulteration in milk samples collected from DS and MM was comparatively higher ($P<0.05$) than that of P and MP (Figure-4).

DISCUSSION

In the present study a wide range of adulterants was detected among which water was common and frequently found in majority of market milk samples (74%) during present study. This was similar to results of Beniwal (1999), who reported that the main adulterant in milk was water found to be in 70% samples among the all samples, while 93.33% samples of milk adulterated with water were recorded by Lateef et al. (2009). It has been noticed that addition of water to normal whole milk was assumed to increase the quantity of milk Bhatti (2010). At the markets of the Khartoum state of Sudan 95% fresh milk sold was also adulterated with water Ahmed (2009). Moreover, Zia (2007) indicated that the milk samples collected from vendors were highly adulterated with water than samples collected from dairy farm. The proportion of samples adulterated with various adulterants varied in different studies. Detergents are usually used to improve the natural state of milk after the addition of water. The adulteration of detergents in pure milk was reported in India (Manish et al. 2000). The proportion of samples adulterated with formalin varied in different studies. For example, in a study conducted by Lateef (2009) reveled 46.66% milk samples adulterated with formalin, 93.33% with cane sugar, 86.66% with urea and 13% with starch among the total samples. It could be agreed that formalin used as preservative of milk to increase the shelf life is not only decreases the nutritive value of milk but also is carcinogenic (Bhatti, 2010 and Afzal et al. 2011). Wadekar (2011) reported that the sodium chloride (NaCl) was added in milk to increase the total solid contents of milk. Pitty (2011), who reported relatively similar milk samples positive to skimmed milk powder and sodium chloride i.e. 6 samples from Mizoram and one from Nagaland. While Sinha (2012) observed 50 (70.42%) milk samples contaminated with glucose and skimmed milk powder out of 71 samples. He further reported that these adulterants are usually added to milk in the lean season to enhance the volumes. The adulteration of ammonium sulfate and other preservatives were also reported by some

researchers. Normally these prohibited chemicals are used to increase the shelf life of milk during transportation and in tough seasons (Goswami and Gupta, 2008).

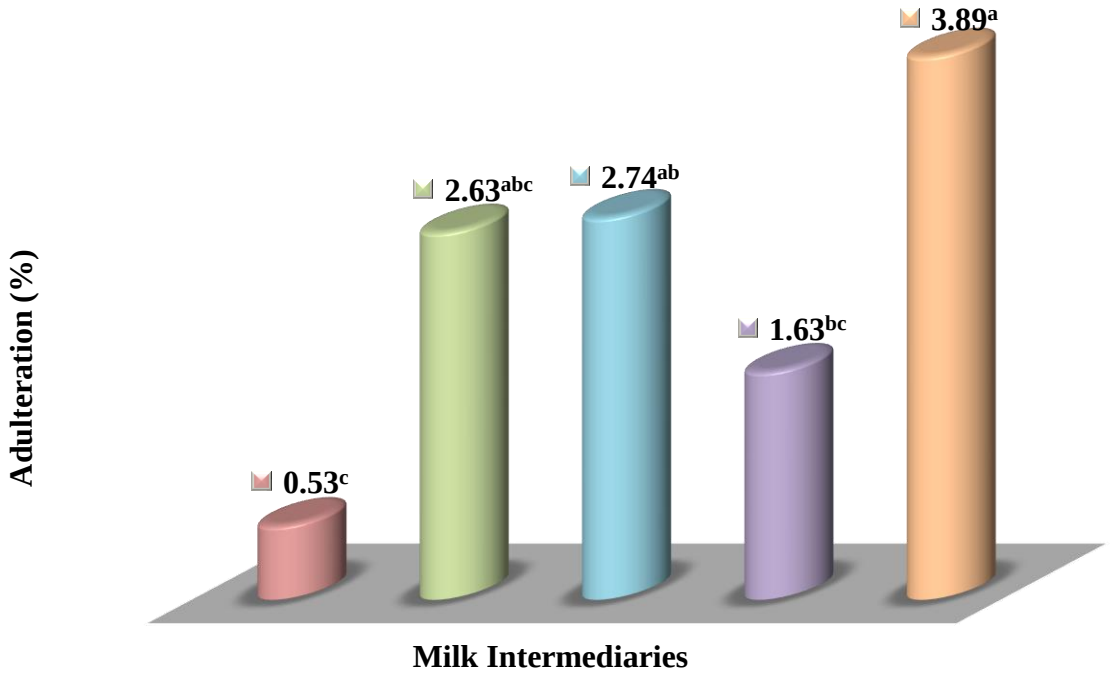

Figure 4
Extent of adulteration in market milk sold by different intermediaries at Shaheed Benazirabad District of Sindh.

Legends: MP = Milk producers, MC = Milk collectors, MM = Middlemen, P = Processors
DS = Dairy shops.
LSD (0.05) = 2.148
SE± = 1.081

In the present study the freezing point of milk samples collected from MP, MC, P and DS was statistically different ($P<0.05$) from each other and varied from control. Present findings are in accordance with the results of Meredith (20), who informed that milk containing extraneous amount of water will have a grossly elevated freezing point. Nida et al. (2013) reported that the addition of extraneous water in milk will have adverse effect on freezing point and nutritional quality.

In the present study it was observed that the extent of extraneous water in milk sold at dairy shops was remarkably higher followed by milk collectors, middlemen and processors than that of milk sold by milk producers. Similar results were recorded by Barham et al. (2014). They reported that the extent of water adulteration was higher in milk collected from milk collector, dairy shops, middlemen and processors than the milk producers at Hyderabad, Sindh.

In the present study the level of adulteration was found to be comparatively higher in milk samples collected from dairy shops and middlemen than the milk samples collected from milk collectors, processors and milk producers. The findings of present study are in agreement with Zia (2007) and Tariq (2001).They reported that in Pakistan raw milk is distributed by a traditional system which involves middlemen called Gawalas. These milk dealers; middlemen and dairy shop keepers adulterate milk to maximize their profit. The results of present study are also supported by Barham et al. (2014).They reported that the percentage of adulteration at dairy shops, milk collectors and middlemen was found remarkably higher than that of processors and milk producers.

CONCLUSION

Collecting facts has shown that, the water was the common adulterant found to be in market milk sold in locality of Shaheed Benazirabad followed by detergent, starch, rice flour, cane sugar, skimmed milk powder, caustic soda, formalin, vegetable oil, hydrogen peroxide, sodium chloride, urea, ammonium sulfate, boric acid, glucose, arrowroot and sorbitol The high ratio of added water and adulteration was recorded at dairy shops (DS), middlemen (MM) and milk collectors (MC) compared to processors (P) and milk producers (MP).

ACKNOWLEDGEMENT

The first author and supervisory committee are very thankful to Higher Education Commission (HEC), Islamabad, Pakistan for awarding Indigenous 5000 PhD fellowship. This portion of PhD research work on "Risk of adulteration in milk consumed at Shaheed Benazirabad District of Sindh" is fully supported by Higher Education Commission (HEC) Islamabad, Pakistan.

Ethical issues

Not applicable.

Informed consent

Not applicable.

Funding

This study has not received any external funding.

Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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